Mad River

Watershed Summary

WATERSHED DESCRIPTION AND MAPS

The Mad River watershed covers an area of approximately 20,318 acres in the northwestern corner of Connecticut (Figure 1). There are three municipalities located in the watershed, including Colebrook, Norfolk, and Winchester, CT.

The Mad River watershed includes three segments impaired for recreation due to elevated bacteria levels. These segments were assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. Some segments in the watershed are currently unassessed as of the writing of this document. This does not suggest that there are no issues on these segments, but indicates a lack of current data to evaluate the segments as part of the assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of some waterbodies in the watershed (CTDEEP, 2010).

The Mad River (Segment 3) (CT4302-00_03) begins at the outlet to the Spaulding Pond Dam in Norfolk, flows easterly through Grantville, and ends at the diversion entrance to the Rugg Brook Reservoir in Winchester. The Mad River (Segment 2a) (CT4302-00_02a) continues easterly from the Rugg Brook Reservoir outlet, continues through the Algonquin State Forest along Route 44, and ends at the Mad River Dam outlet. The Mad River (Segment 1) (CT4302-00_01) begins downstream of the Mad River Dam outlet, continues through the City of Winsted, and ends at the confluence with the Still River (Figures 2 and 5).

Segment 1 of the Mad River has a water quality classification of B. Designated uses include habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. The Mad River (Segment 2a) has a water quality classification of A. Designated uses include potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. The Mad River (Segment 3) has a water quality classification of AA. Designated uses include existing or proposed drinking water supplies, habitat for fish and other aquatic life and wildlife,

Impaired Segment Facts

Impaired Segments:
1. Mad River (Segment 1) (CT4302-00_01)
2. Mad River (Segment 2a) (CT4302-00_02a)
3. Mad River (Segment 3) (CT4302-00_03)

Municipalities: Norfolk and Winchester

Impaired Segment Lengths (miles) and Water Quality Classifications:
CT4302-00_01: 2.24, Class B
CT4302-00_02a: 1.77, Class A
CT4302-00_03: 5.17, Class AA

Designated Use Impairments: Recreation

Sub-regional Basin Name and Code: Mad River, 4302

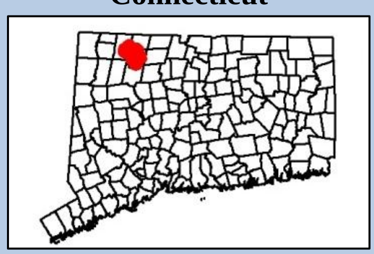
Regional Basin: Farmington

Major Basin: Connecticut

Watershed Area (acres): 20,318

MS4 Applicable? No

Figure 1: Watershed location in Connecticut

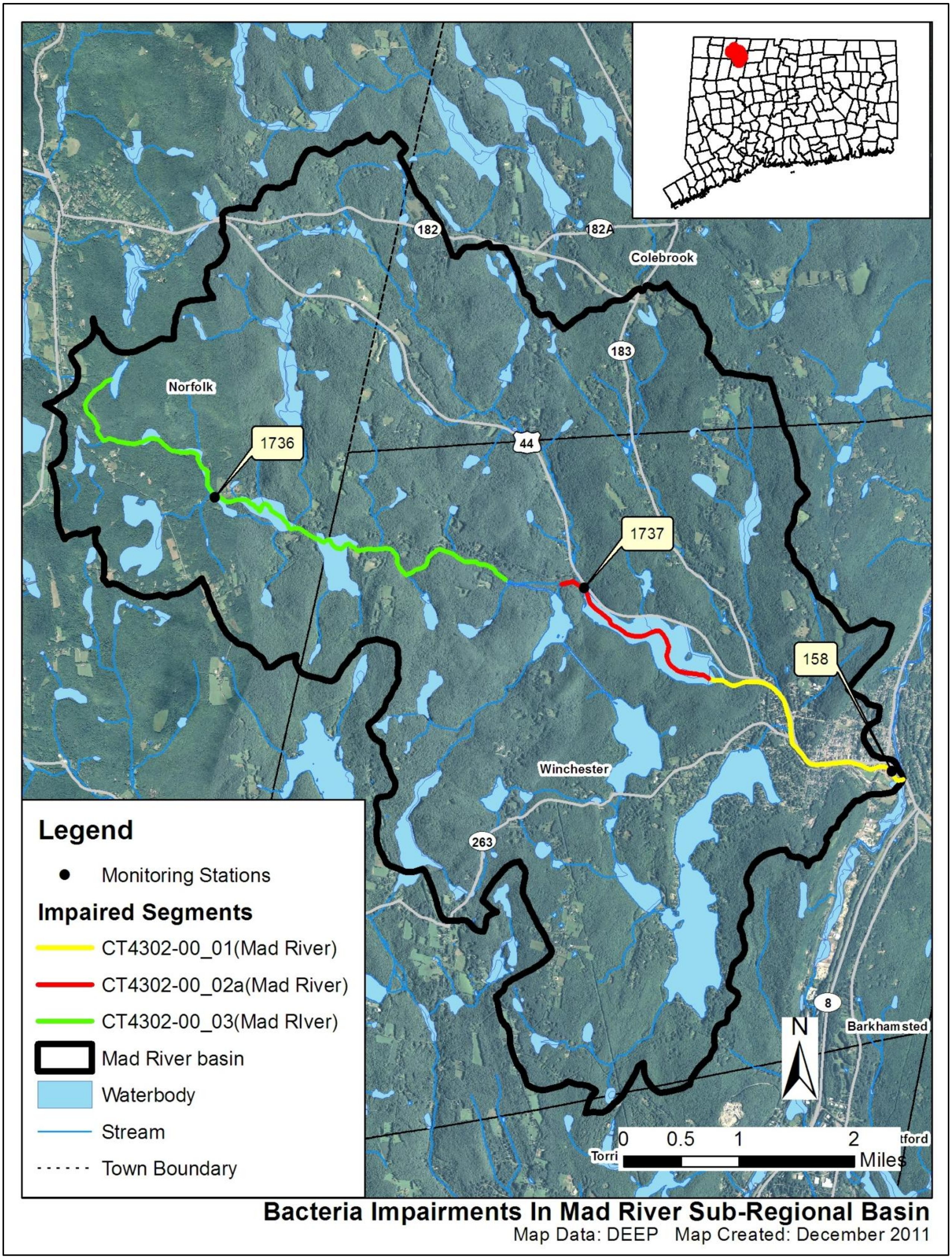


recreation, and industrial and agricultural water supply. These segments are impaired due to elevated bacteria concentrations, affecting the designated use of recreation. As there are no designated beaches in these segments of the Mad River, the specific recreation impairments are for non-designated swimming and other water contact related activities.

Table 1: Impaired segments and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT4302-00_01	Mad River (Winchester)-01	From mouth at Still River, US to Mad River Dam outlet, Winchester.	2.24	NOT	NOT	FULL
CT4302-00_02a	Mad River (Winchester)-02a	From Mad River Dam outlet, Winchester, US to outlet from Rugg Brook Reservoir.	1.77	U	NOT	FULL
CT4302-00_02b	Mad River (Winchester)-02b	From confluence with Rugg Brook Reservoir outlet, US to diversion entrance for Rugg Brook Reservoir.	0.63	NOT	U	FULL
CT4302-00_03	Mad River (Winchester)-03	From diversion entrance for Rugg Brook Reservoir (boundary of drinking water watershed), US to headwaters at Spaulding Pond outlet dam, Norfolk.	5.17	FULL	NOT	FULL
Shaded cells indicate impaired segment addressed in this TMDL						
FULL = Designated Use Fully Supported						
NOT = Designated Use Not Supported						
U = Unassessed						

Figure 2: GIS map featuring general information of the Mad River watershed at the sub-regional level (the location and name of each sampling station is indicated on each segment)



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Mad River watershed consists of 64% forest, 27% urban, 5% water, and 4% agriculture. The northern and central portions of the watershed near the Mad River (Segments 3 and 2a) are characterized by forested land use with some agricultural operations scattered throughout the watershed. This area surrounding the Mad River (Segment 1) is characterized by developed land use, particularly in the Town of Winsted (Figure 4).

Figure 3: Land use within the Mad River watershed

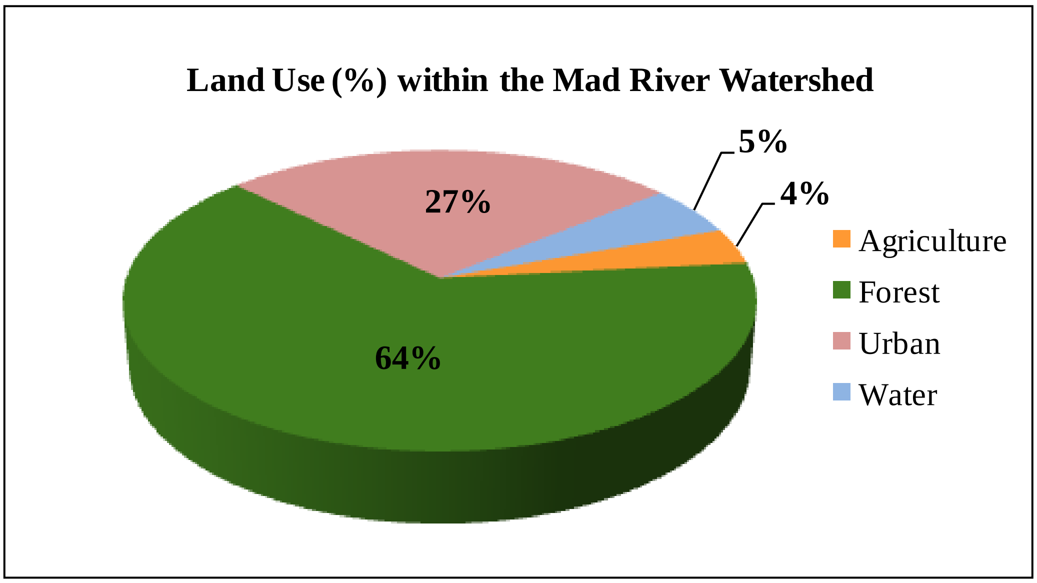
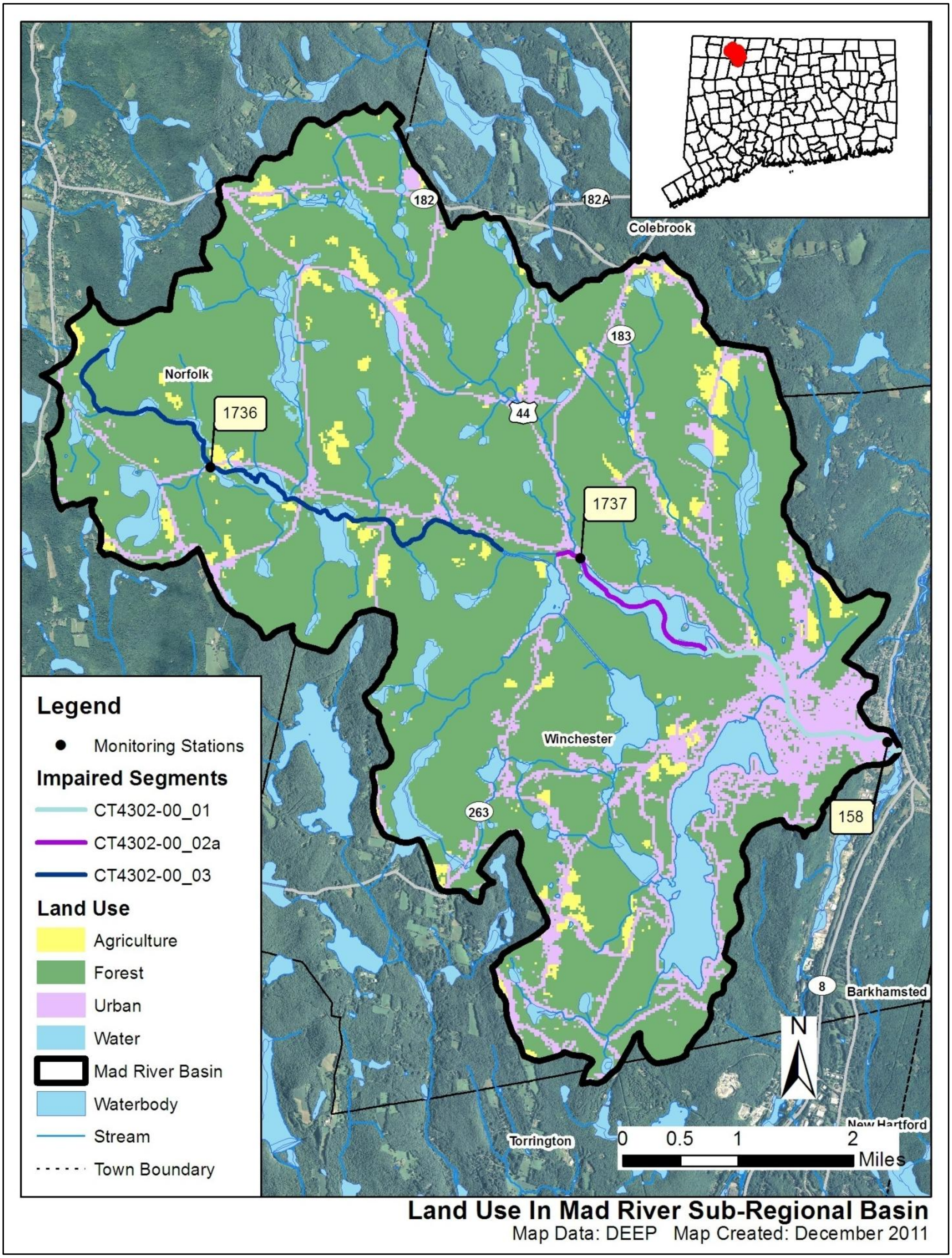


Figure 4: GIS map featuring land use for the Mad River watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired segments.

Table 2: Sampling station location description for impaired segments in the Mad River watershed (stations organized downstream to upstream)

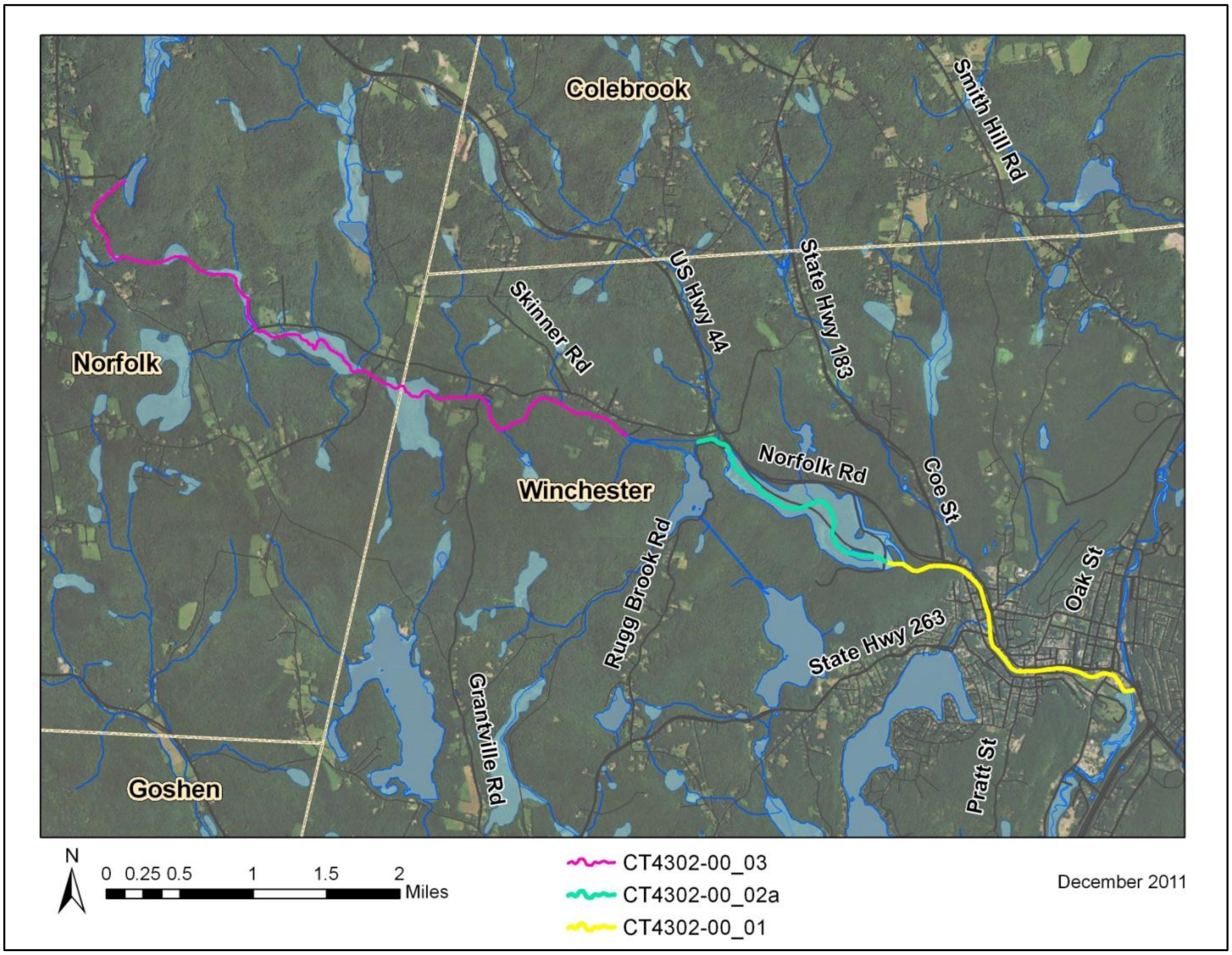
Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT4302-00_01	Mad River	158	Mouth and Old Route 8 crossing	Winchester	41.919919	-73.059708
CT4302-00_02a	Mad River	1737	upper entrance to Mad River FCA	Winchester	41.942867	-73.111597
CT4302-00_03	Mad River	1736	Grantville Road at Smith Pond outlet	Norfolk	41.954053	-73.173931

The Mad River (Segment 1) (CT4302-00_01) is a Class B freshwater river (Figure 5). Its applicable designated uses are habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. The Mad River (Segment 2a) (CT4302-00_02a) is a Class A freshwater river (Figure 5). Its applicable designated uses are potential drinking water supply, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. The Mad River (Segment 3) (CT4302-00_03) is a Class AA freshwater river (Figure 5). Its applicable designated uses are an existing or proposed drinking water supply, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from one sampling location on each impaired segment of the Mad River (Table 2).

The water quality criteria for *E. coli*, along with bacteria sampling results from all sample years, are presented in Tables 6 - 8. For the Mad River (Segment 1), samples were collected from 2006-2009 at Station 158, and the annual geometric mean exceeded the WQS for *E. coli* during all sample years. Single sample values for Station 158 also exceeded the WQS for *E. coli* on multiple dates. For the Mad River (Segment 2a), samples were collected from 2004-2008 at Station 1737, and the annual geometric mean value exceeded the WQS for *E. coli* in 2004. Single sample values for Station 1737 exceeded the WQS for *E. coli* on multiple dates in 2004, 2007, and 2008. For the Mad River (Segment 3), samples were collected from 2004-2008 at Station 1736, and the annual geometric mean value did not exceed the WQS for *E. coli*. Single sample values for Station 1736 exceeded the WQS in 2004, 2005, and 2008.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days, where appropriate (Tables 6 - 8). For the Mad River (Segment 1), the geometric means exceeded the WQS for *E. coli* during both wet and dry-weather. For the Mad River (Segments 2a and 3), the geometric means did not exceed the WQS for *E. coli* during wet or dry-weather.

Figure 5: Aerial map of the Mad River



Due to the elevated bacteria measurements presented in Tables 6 - 8, these three impaired segments did not meet CT's bacteria WQS, were identified as impaired, and were placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segments. Further monitoring and investigation will confirm listed sources and discover additional ones. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not suggest that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources in the Mad River watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/Pets	Other
Mad River CT4302-00_01 (Segment 1)	x	x		x	x	x	x	
Mad River CT4302-00_02a (Segment 2a)	x			x	x	x	x	
Mad River CT4302-00_03 (Segment 3)	x			x	x	x	x	x

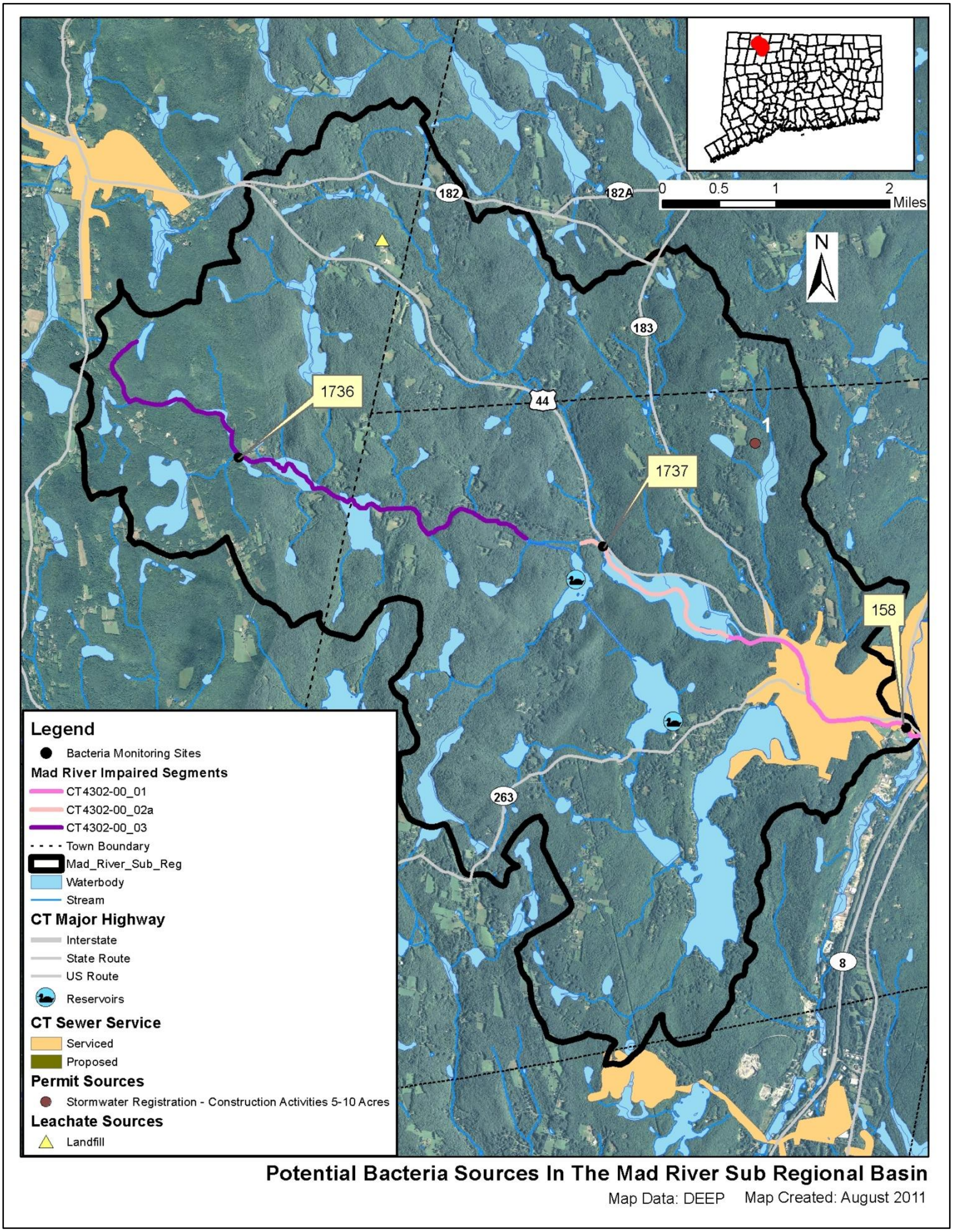
Point Sources

Permitted sources within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring may reveal the presence of additional discharges in the watershed.

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	0
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	0
GSI	Stormwater Associated with Industrial Activity	0
GSM	Part B Municipal Stormwater MS4	0
GSN	Stormwater Registration – Construction	1
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	0

Figure 6: Potential sources in the Mad River watershed at the sub-regional level



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Permitted Sources

As shown in Table 5, there is one permitted discharge in the Mad River watershed. Bacteria data from this permitted facility are not currently available. Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the Mad River watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Winchester	True Blue Environmental Services Llc	GSN001690	Stormwater Registration - Construction Activities 5-10 Acres	Conndot Winchester Maintenance & Repair Facility	1

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

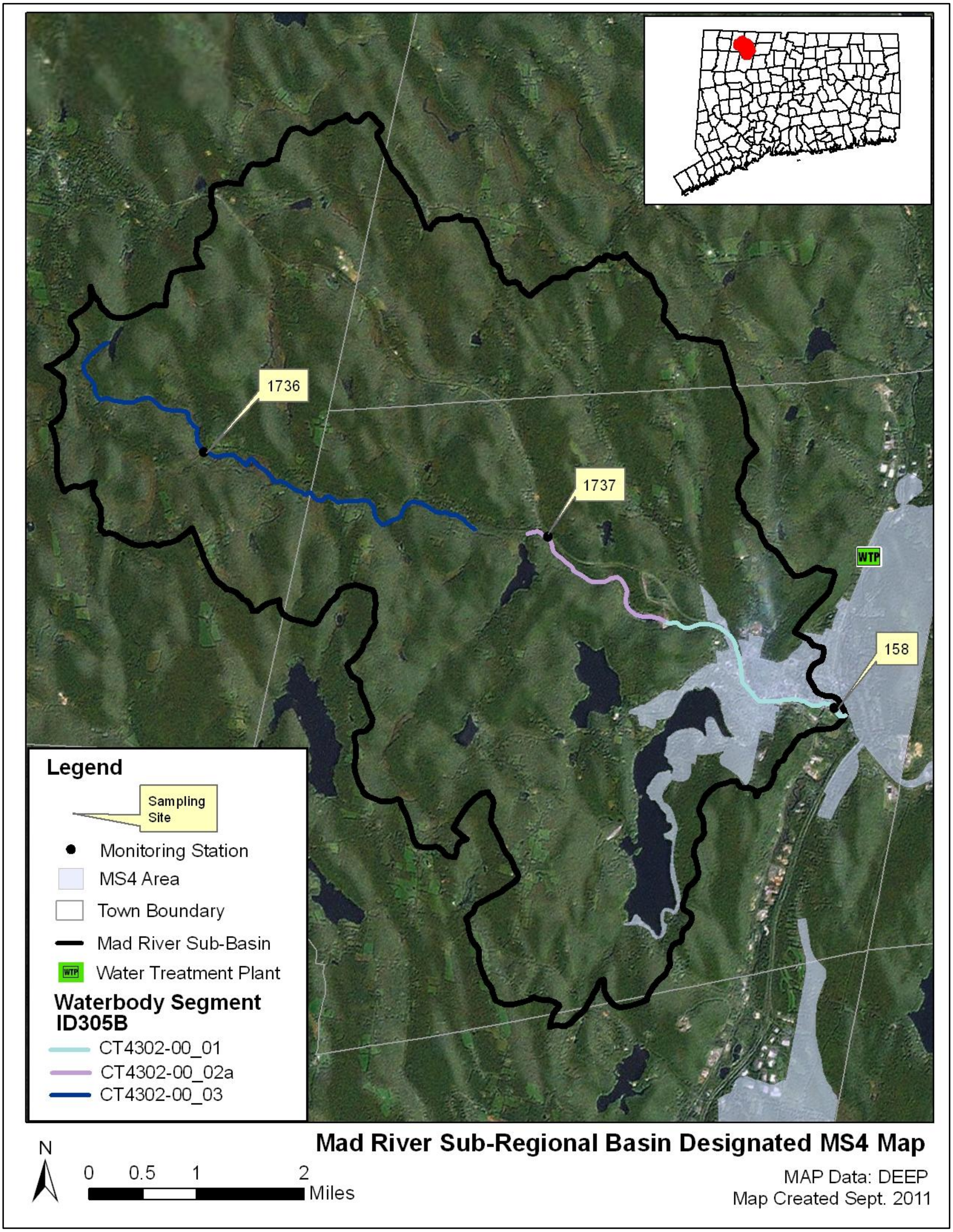
While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

The impaired segments of the Mad River watershed are located within the Towns of Winchester and Norfolk. Winchester is a designated urban cluster, as defined by the U.S. Census Bureau, and is required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the Connecticut Department of Energy and Environmental Protection (DEEP) (Figure 7). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit requires municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. The MS4 permit is discussed further in the "TMDL Implementation Guidance" section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CT DEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Figure 7: MS4 areas of the Mad River watershed



Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the Mad River watershed are described below.

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Mad River watershed represent a potential source of bacteria. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001). As the majority of the watershed is undeveloped, particularly in the upper portion of the watershed, and there are multiple reservoirs near the impaired segments of the Mad River (Figure 6), waterfowl and wildlife waste is a potential source of bacteria to the Mad River.

Geese and other waterfowl are known to congregate in open areas including recreational fields, agricultural cropfields, golf courses, and large reservoirs. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants.

The southeastern portion of the watershed in Winsted and areas along major highways are characterized by residential development and much of this development is located near the impaired segments. Waste from domestic animals, such as dogs, may also be contributing to bacteria concentrations in the Mad River, particularly for the Mad River (Segment 1).

Illicit Discharges and Insufficient Septic Systems

As shown in Figure 6, the majority of the Mad River watershed relies on onsite wastewater treatment systems, such as septic systems. The upper portion of the watershed near the Mad River (Segments 2a and 3) rely solely on septic systems. Properly managed septic systems and leach fields have the ability to effectively remove bacteria from waste. If systems are not maintained, waste will not be adequately treated and may result in bacteria reaching nearby surface and ground water. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Towns of Winchester and Norfolk do not have specific health directors and are part of the Torrington Area Health District (http://www.tahd.org/).

A portion of the watershed in the City of Winsted surrounding the Mad River (Segment 1) is serviced by the municipal sanitary sewer system. Sewer system leaks and other illicit discharges can contribute bacteria to nearby surface waters and is a potential source of bacteria to the Mad River.

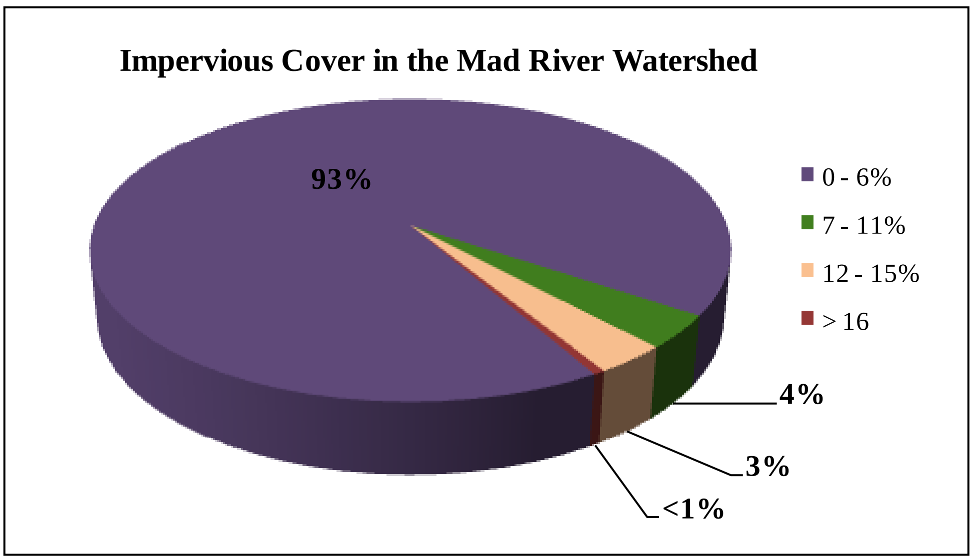
High geometric means during dry-weather may indicate the presence of insufficient septic systems, leaking sewer pipes, or other illicit discharges. As shown in Table 7, the geometric mean during dry weather exceeded the WQS at one station on the Mad River (Segment 1) (Station 158). As noted previously, the area around the Mad River (Segment 1) is serviced by the municipal sanitary sewer system and may be receiving bacteria from leaks in the systems or other illicit discharges.

Stormwater Runoff from Developed Areas

Approximately 27% of the Mad River watershed is developed, particularly along the eastern portion of the watershed in Winsted and along major highways (Figure 3). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000).

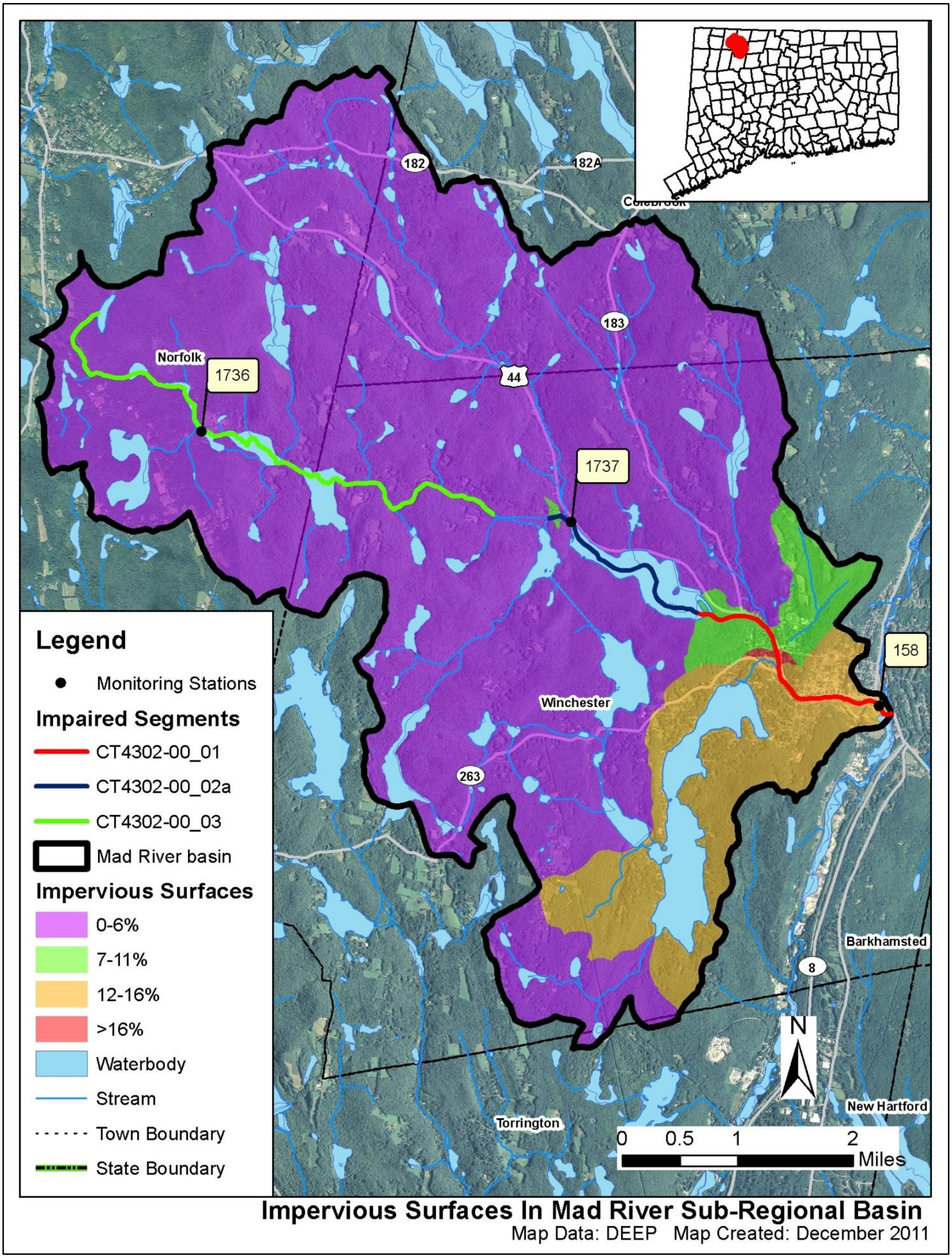
The majority of the Mad River watershed has less than 6% impervious surfaces (Figures 8 and 9). However, portions of the watershed near the eastern portion of the watershed have a higher percentage of impervious cover (Figure 9). In particular, the area surrounding the Mad River (Segment 1) in the City of Winsted has an impervious cover greater than 7% with some the extreme eastern areas ranging from 12-15%, indicating that stormwater runoff may be a source of bacteria (Figure 9).

Figure 8: Range of impervious cover (%) in the Mad River watershed



High geometric means during wet-weather may indicate that stormwater runoff is contributing to the bacterial impairment in a river segment. As shown in Table 7, the geometric mean during wet-weather exceeded the WQS at Station 158 on the Mad River (Segment 1).

Figure 9: Impervious cover (%) for the Mad River sub-regional watershed



Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of vegetated buffer along the shoreline. Agricultural land use makes up 4% of the Mad River watershed. Agricultural operations are scattered throughout the watershed with some located directly adjacent to the Mad River (Segment 3) (Figure 4). Agricultural runoff is likely a source of bacteria to the Mad River.

Additional Sources

The landfill just north of Route 44 in Norfolk (Figure 9) may also be contributing bacteria to the upper segments of the Mad River. There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in the Mad River watershed. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

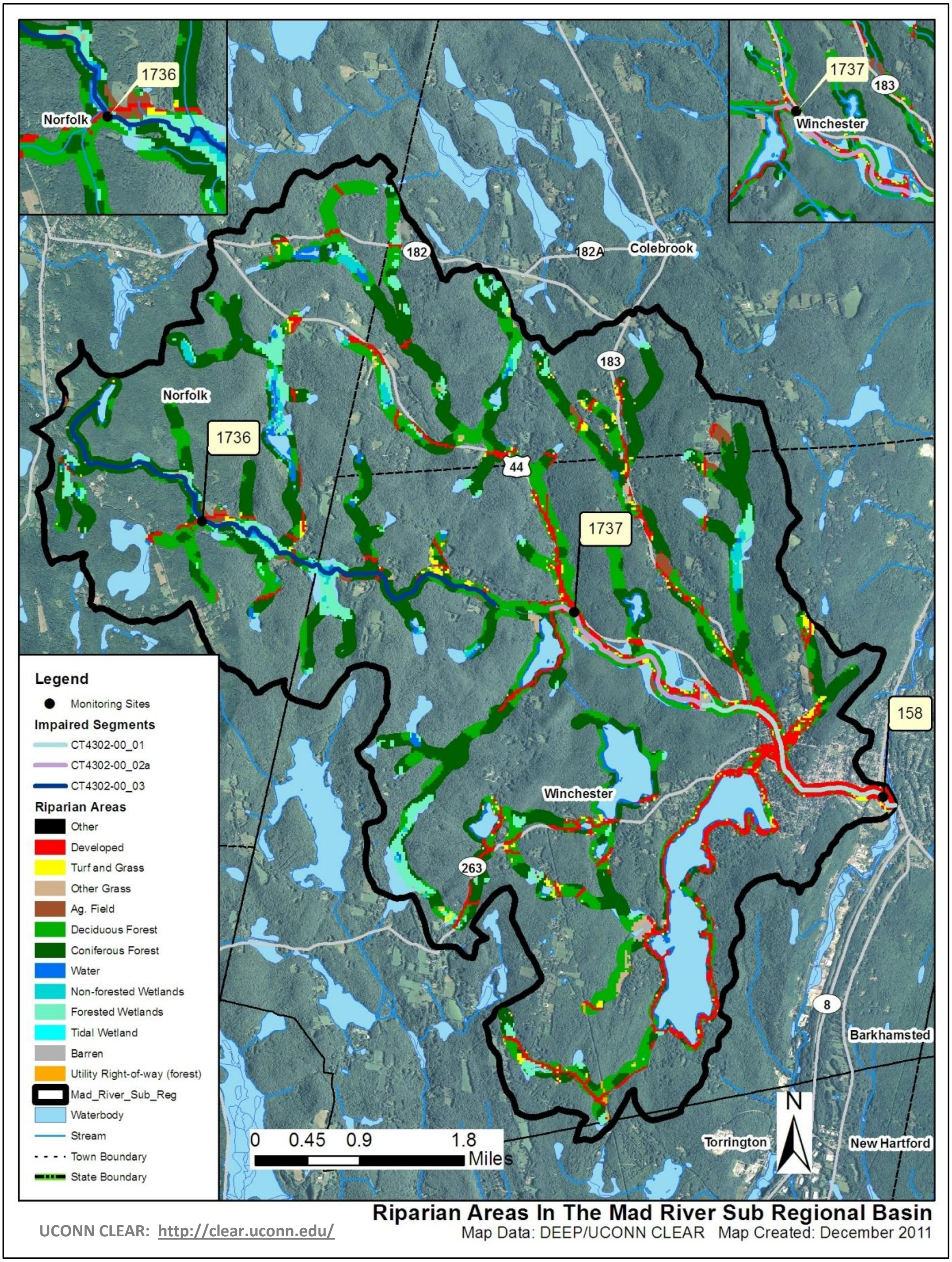
Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (http://clear.uconn.edu/), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The riparian zones for the impaired segments of the Mad River are characterized by a mix of urban and forested areas (Figure 10). An agricultural field is located in the riparian zone of the Mad River (Segment 3). As previously noted, agricultural and developed areas within the riparian zone can contribute pollutants such as bacteria to a waterbody since the natural riparian buffer is not available to treat runoff.

Figure 10: Riparian buffer zone information for the Mad River watershed



RECOMMENDED NEXT STEPS

Future mitigative activities are necessary to ensure the long-term protection of the Mad River and have been prioritized below.

1) Evaluate municipal programs regarding animal waste.

Any education and outreach program in the watershed should highlight the importance of not feeding waterfowl and wildlife and managing waste from horses, dogs, and other pets. The towns and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas of the impaired segments that are frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans, may contribute to water quality impairments in the Mad River watershed and can harm human health and the environment. Particular attention should be paid to the reservoirs surrounding the Mad River (Segment 2a). Animal wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

2) Develop a system to monitor septic systems.

Many residents of the Mad River watershed rely on septic systems. If not already in place, all municipalities within the watershed should establish a program to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could also be adopted. Municipalities can also develop programs to assist citizens with the replacement and repair of older and failing systems.

3) Implement a program to evaluate the sanitary sewer system.

Some residents of the Mad River watershed rely on a municipal sewer system (Figure 9), including those residents near Segment 1 of the river in Winsted. It is important for Winchester to develop a program to evaluate its sanitary sewer system and reduce leaks and overflows. This program should include periodic inspections of the sewer line.

4) Identify areas in the Mad River watershed to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, 27% of the Mad River watershed is considered urban. Most of the watershed has an impervious cover of less than 6%, though areas near the impaired segment (Segment 1) have a higher level of impervious cover and have shown high wet-weather concentrations of bacteria. As such, stormwater runoff may be contributing bacteria to the Mad River. To identify specific areas that are contributing bacteria to the impaired segments, Norfolk and Winchester should conduct wet-weather sampling at stormwater outfalls that discharge directly to the impaired segments of Mad River watershed. To treat stormwater runoff, the town should identify areas along the river to install BMPs designed to encourage stormwater to infiltrate into the ground before entering the waterbodies. These BMPs would disconnect impervious areas and reduce pollutant loads to the river. More detailed information and BMP recommendations can be found in the core TMDL document. Particular attention should be paid to the portion of the Mad River that flows through Winsted, as the wet-weather geometric mean was high at Station 158 on Segment 1 (Table 7).

Towns that are not MS4 communities could also choose to adopt the 6 minimum measures required under the MS4 permit. Though not required, adopting these minimum measures would provide a framework for addressing areas of the watershed that may be contributing bacteria through stormwater runoff. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the state. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach
2. Public Involvement/Participation
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post-construction stormwater management in the new development and redevelopment
6. Pollution prevention/good housekeeping for municipal operations

5) Ensure there are sufficient buffers on agricultural lands in the Mad River watershed.

If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place. Particular attention should be paid to the agricultural operation in the riparian zone of Segment 3.

6) Continue monitoring of permitted sources.

Monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 6 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Mad River watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 6. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

		Instantaneous *E. coli* (#/100mL)						**Geometric Mean *E. coli* (#/100mL)**	
Class	**Bacteria Source**	**WLA[6]**			**LA[6]**			**WLA[6]**	**LA[6]**
	Recreational Use	1	2	3	1	2	3	**All**	**All**
A	Non-Stormwater NPDES	0	0	0				0	
	CSOs	0	0	0				0	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235[7]	410[7]	576[7]				126[7]	
	Stormwater (non-MS4)				235[7]	410[7]	576[7]		126[7]
	Wildlife direct discharge				235[7]	410[7]	576[7]		126[7]
	Human or domestic animal direct discharge[5]				235	410	576		126
AA	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235[7]	410[7]	576[7]				126[7]	
	Stormwater (non-MS4)				235[7]	410[7]	576[7]		126[7]
	Wildlife direct discharge				235[7]	410[7]	576[7]		126[7]
	Human or domestic animal direct discharge[5]				235	410	546		126
B[4]	Non-Stormwater NPDES	235	410	576				126	
	CSOs	235	410	576				126	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	

	Stormwater (MS4s)	235[7]	410[7]	576[7]				126[7]	
	Stormwater (non-MS4)				235[7]	410[7]	576[7]		126[7]
	Wildlife direct discharge				235[7]	410[7]	576[7]		126[7]
	Human or domestic animal direct discharge[5]				235	410	576		126

(1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.

(2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

(3) **All Other Recreational Uses.**

(4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)

(5) Human direct discharge = swimmers

(6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(7) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 7: Mad River (Segment 1) Bacteria Data

Waterbody ID: CT4302-00_01

Characteristics: Freshwater, Class B, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100ml

Percent Reduction to meet TMDL:

Geometric Mean: **52%**

Single Sample: **89%**

Data: 2006 - 2009 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* data (colonies/100 mL) from Station 158 on the Mad River (Segment 1) with annual geometric means calculated

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
158	Between Mouth and Old Route 8 crossing	6/1/2006	41	dry	194
158	Between Mouth and Old Route 8 crossing	6/14/2006	86	dry	
158	Between Mouth and Old Route 8 crossing	6/29/2006	800	wet	
158	Between Mouth and Old Route 8 crossing	7/12/2006	74	dry	
158	Between Mouth and Old Route 8 crossing	7/19/2006	710	dry	
158	Between Mouth and Old Route 8 crossing	7/26/2006	110	dry	
158	Between Mouth and Old Route 8 crossing	8/2/2006	320	dry	
158	Between Mouth and Old Route 8 crossing	8/9/2006	1200	wet	
158	Between Mouth and Old Route 8 crossing	8/14/2006	160	dry	
158	Between Mouth and Old Route 8 crossing	8/23/2006	74	dry	

Single sample *E. coli* data (colonies/100 mL) from Station 158 on the Mad River (Segment 1) with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
158	Between Mouth and Old Route 8 crossing	6/6/2007	350	wet	**261*** **(52%)**
158	Between Mouth and Old Route 8 crossing	6/12/2007	230	dry	
158	Between Mouth and Old Route 8 crossing	6/27/2007	320	dry	
158	Between Mouth and Old Route 8 crossing	7/5/2007	910	wet	
158	Between Mouth and Old Route 8 crossing	7/10/2007	149†	dry	
158	Between Mouth and Old Route 8 crossing	7/17/2007	155†	wet	
158	Between Mouth and Old Route 8 crossing	7/25/2007	370	wet	
158	Between Mouth and Old Route 8 crossing	8/2/2007	150	dry	
158	Between Mouth and Old Route 8 crossing	8/9/2007	1000	wet	
158	Between Mouth and Old Route 8 crossing	8/30/2007	150	dry	
158	Between Mouth and Old Route 8 crossing	9/6/2007	63	dry	
158	Between Mouth and Old Route 8 crossing	9/13/2007	360	wet	
158	Between Mouth and Old Route 8 crossing	5/22/2008	41	wet	224
158	Between Mouth and Old Route 8 crossing	6/5/2008	74	wet	
158	Between Mouth and Old Route 8 crossing	6/9/2008	2600	wet	
158	Between Mouth and Old Route 8 crossing	6/19/2008	210	wet	
158	Between Mouth and Old Route 8 crossing	6/26/2008	97	dry	
158	Between Mouth and Old Route 8 crossing	7/8/2008	85	dry	
158	Between Mouth and Old Route 8 crossing	7/23/2008	**3700*** **(89%)**	wet	
158	Between Mouth and Old Route 8 crossing	7/31/2008	230	wet	
158	Between Mouth and Old Route 8 crossing	8/4/2008	63	wet	
158	Between Mouth and Old Route 8 crossing	8/14/2008	130	dry	
158	Between Mouth and Old Route 8 crossing	9/9/2008	760	wet	

Single sample *E. coli* data (colonies/100 mL) from Station 158 on the Mad River (Segment 1) with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
158	Between Mouth and Old Route 8 crossing	6/11/2009	480	wet	240
158	Between Mouth and Old Route 8 crossing	6/17/2009	270†	wet	
158	Between Mouth and Old Route 8 crossing	7/2/2009	290	wet	
158	Between Mouth and Old Route 8 crossing	7/9/2009	110	dry	
158	Between Mouth and Old Route 8 crossing	7/16/2009	86	dry	
158	Between Mouth and Old Route 8 crossing	7/23/2009	320	wet	
158	Between Mouth and Old Route 8 crossing	8/6/2009	350	dry	
158	Between Mouth and Old Route 8 crossing	8/12/2009	150	dry	
158	Between Mouth and Old Route 8 crossing	8/19/2009	440	dry	

Shaded cells indicate an exceedance of water quality criteria

†Average of two duplicate samples

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for Station 158 on the Mad River (Segment 1)

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
158	Between Mouth and Old Route 8 crossing	2006-2009	22	23	225	363	143

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gage at the Norfolk 2 SW in Norfolk, CT

Table 8: Mad River (Segment 2a) Bacteria Data

Waterbody ID: CT4302-00_02a

Characteristics: Freshwater, Class A, Potential Public Drinking Water Supply, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, Navigation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **61%**

Single Sample: **86%**

Data: 2004-2008 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* data (colonies/100 mL) from Station 1737 on the Mad River (Segment 2a) with annual geometric means calculated

Station Name	Station Location	Date	Results	Wet/ Dry	Geomean
1737	At upper entrance to Mad River Flood Control Area	7/9/2004	140	wet	**319* (61%)**
1737	At upper entrance to Mad River Flood Control Area	7/27/2004	230	dry	
1737	At upper entrance to Mad River Flood Control Area	8/31/2004	200	dry	
1737	At upper entrance to Mad River Flood Control Area	9/28/2004	**3000* (86%)**	wet	
1737	At upper entrance to Mad River Flood Control Area	10/19/2004	170	wet	
1737	At upper entrance to Mad River Flood Control Area	3/29/2005	60	wet	29
1737	At upper entrance to Mad River Flood Control Area	4/28/2005	10	wet	
1737	At upper entrance to Mad River Flood Control Area	5/19/2005	10	dry	
1737	At upper entrance to Mad River Flood Control Area	6/16/2005	120	dry	
1737	At upper entrance to Mad River Flood Control Area	8/18/2005	10	dry	
1737	At upper entrance to Mad River Flood Control Area	9/22/2005	60	dry	
1737	At upper entrance to Mad River Flood Control Area	10/20/2005	40	dry	

Single sample *E. coli* data (colonies/100 mL) from Station 1737 on the Mad River (Segment 2a) with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/ Dry	Geomean
1737	At upper entrance to Mad River Flood Control Area	3/30/2006	10	dry	33
1737	At upper entrance to Mad River Flood Control Area	4/26/2006	24	wet	
1737	At upper entrance to Mad River Flood Control Area	5/24/2006	10	dry	
1737	At upper entrance to Mad River Flood Control Area	6/14/2006	10	dry	
1737	At upper entrance to Mad River Flood Control Area	7/19/2006	40	dry	
1737	At upper entrance to Mad River Flood Control Area	7/21/2006	80	dry	
1737	At upper entrance to Mad River Flood Control Area	8/30/2006	350	wet	
1737	At upper entrance to Mad River Flood Control Area	9/20/2006	10	wet	
1737	At upper entrance to Mad River Flood Control Area	10/18/2006	190	wet	
1737	At upper entrance to Mad River Flood Control Area	4/11/2007	1	dry	21
1737	At upper entrance to Mad River Flood Control Area	5/9/2007	10	dry	
1737	At upper entrance to Mad River Flood Control Area	7/11/2007	220	dry	
1737	At upper entrance to Mad River Flood Control Area	8/8/2007	20	wet	
1737	At upper entrance to Mad River Flood Control Area	9/12/2007	860	wet	
1737	At upper entrance to Mad River Flood Control Area	10/10/2007	2	wet	
1737	At upper entrance to Mad River Flood Control Area	4/9/2008	2	dry	25
1737	At upper entrance to Mad River Flood Control Area	5/14/2008	2	dry	
1737	At upper entrance to Mad River Flood Control Area	6/11/2008	130	wet	
1737	At upper entrance to Mad River Flood Control Area	7/9/2008	30	dry	
1737	At upper entrance to Mad River Flood Control Area	8/13/2008	250	wet	
1737	At upper entrance to Mad River Flood Control Area	9/10/2008	800	wet	
1737	At upper entrance to Mad River Flood Control Area	10/8/2008	10	dry	
1737	At upper entrance to Mad River Flood Control Area	11/12/2008	5	dry	

Shaded cells indicate an exceedance of water quality criteria

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for Station 1737 on the Mad River (Segment 2a)

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
1737	At upper entrance to Mad River Flood Control Area	2004-2008	15	20	39	97	19

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gage at the Norfolk 2 SW in Norfolk, CT

Table 9: Mad River (Segment 3) Bacteria Data

Waterbody ID: CT4302-00_03

Characteristics: Freshwater, Class AA, Existing or Proposed Public Drinking Water Supply, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, Navigation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **NA**

Single Sample: **59%**

Data: 2004 - 2008 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* data (colonies/100 mL) from Station 1736 on the Mad River (Segment 3) with annual geometric means calculated

Station Name	Station Location	Date	Results	Wet/ Dry	Geomean
1736	Downstream of Grantville Road crossing at Smith Pond	7/9/2004	10	wet	52
1736	Downstream of Grantville Road crossing at Smith Pond	7/27/2004	10	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	8/31/2004	210	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	9/28/2004	930	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	10/19/2004	20	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	3/29/2005	30	wet	29
1736	Downstream of Grantville Road crossing at Smith Pond	4/28/2005	10	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	5/19/2005	10	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	6/16/2005	10	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	8/18/2005	430	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	9/22/2005	60	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	10/20/2005	20	dry	

Single sample *E. coli* data (colonies/100 mL) from Station 1736 on the Mad River (Segment 3) with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
1736	Downstream of Grantville Road crossing at Smith Pond	3/30/2006	10	dry	30
1736	Downstream of Grantville Road crossing at Smith Pond	4/26/2006	14	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	5/24/2006	10	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	6/14/2006	10	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	7/19/2006	280	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	7/21/2006	20	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	8/30/2006	210	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	9/20/2006	20	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	10/18/2006	60	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	4/11/2007	1	dry	26
1736	Downstream of Grantville Road crossing at Smith Pond	5/9/2007	10	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	7/11/2007	30	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	8/8/2007	40	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	9/12/2007	290	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	10/10/2007	94	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	4/9/2008	2	dry	40
1736	Downstream of Grantville Road crossing at Smith Pond	5/14/2008	12	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	6/11/2008	110	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	7/9/2008	40	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	8/13/2008	**1000* (59%)**	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	9/10/2008	450	wet	
1736	Downstream of Grantville Road crossing at Smith Pond	10/8/2008	30	dry	
1736	Downstream of Grantville Road crossing at Smith Pond	11/12/2008	5	dry	
Shaded cells indicate an exceedance of water quality criteria					
***Indicates single sample and geometric mean values used to calculate the percent reduction**					

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for Station 1736 on the Mad River (Segment 3)

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
1736	Downstream of Grantville Road crossing at Smith Pond	2004-2008	15	20	34	74	19

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gage at the Norfolk 2 SW in Norfolk, CT

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